CLAIMS

1. An optical path length adjuster (53) for varying an optical path length between an input optical path (52) and an output optical path (54), comprising:

a plurality of first optical elements (61) and second optical elements (62) arranged in alternating sequence along an optical path, each first optical element for determining a polarisation state of a light beam passing through that element and each second optical element for selectively transmitting or reflecting a light beam incident on that element depending on the selected polarisation state of the incident light beam,

wherein the optical path length traversed by an input beam on the optical path can be varied by selecting a particular second optical element at which reflection of the input beam is to occur, the reflected input beam emerging along the output optical path.

2. The adjuster of claim 1, further comprising a plurality of different spacings between adjacent first (61) and second optical elements (62).

3. The adjuster of claim 2, wherein the spacings between adjacent first (61) and second (62) optical elements have different thicknesses depending on the optical path lengths required along the optical path.

4. The adjuster of claim 2 or claim 3, wherein the spacings between adjacent first (61) and second (62) optical elements are occupied by spacing media.

5. The adjuster of claim 4, wherein the spacing media between adjacent first (61) and second (62) optical elements have different refractive indices depending on the optical path lengths required along the optical path.

6. The adjuster of claim 4 or claim 5, wherein the spacing media between adjacent first (61) and second (62) optical elements includes glass substrates (63).

7. The adjuster of any preceding claim, wherein the plurality of first optical elements (61) and second optical elements (62) are arranged in a layered stack configuration (60).

8. The adjuster of claim 1 or claim 7, wherein the first optical element (61) comprises a polarising switch (61a, 61b, 61c) capable of changing the polarisation state of a light beam passing through the element.

9. The adjuster of claim 8, wherein the polarising switch (61a, 61b, 61c) is supported by a glass substrate (63).

10. The adjuster of claim 8, wherein the polarising switch (61a, 61b, 61c) is a liquid crystal cell.

11. The adjuster of claim 1 or claim 8, wherein the second optical element (62) comprises a wire grid polariser (62a, 62b, 62c).

12. The adjuster of claim 11, wherein the wire grid polariser (62a, 62b, 62c) is supported by a glass substrate (63).

13. The adjuster of claim 1 or claim 8, wherein the second optical element (62) comprises a cholesteric polariser.

14. The adjuster of claim 13, wherein the cholesteric polariser is supported by a glass substrate (63).

15. The adjuster of claim 11 or claim 12, wherein consecutive wire grid polarisers (62a, 62b, 62c) are arranged so as to have parallel planes and

such that the direction of the wires are orthogonal to the direction of the wires of the preceding wire grid polariser.

16. The adjuster of claim 7, wherein the input beam enters the stack (60) through a face layer of the stack, the face layer being a said first optical element (61).

17. The adjuster of claim 16, wherein the stack (60) has a base layer which is reflective only.

18. The adjuster of claim 17, wherein the base layer is a plane mirror.

19. The adjuster of claim 17, wherein the output beam leaves the stack (60) through the face layer, the output beam resulting from reflection by either a selected second optical element (62) or the base layer.

20. The adjuster of claim 1, wherein the spacing (d_1, d_2) between sequential second optical elements (62) determines the possible optical path lengths along the optical path.

21. The adjuster of any preceding claim combined with at least one further optical path length adjuster of any preceding claim in a cascade formation, such that the output optical path (54) of the first said optical path length adjuster (53) forms the input path (52) of a successive said further optical path length adjuster.

22. A display device for generating a three-dimensional volumetric image, comprising:

a two-dimensional image display panel (41, 46) for generating a two-dimensional image;

a first focusing element (42, 47) for projecting the two-dimensional image to a virtual image (40, 45) in an imaging volume (44, 49); and

means (43, 48, 53) for altering the effective optical path length between the display panel and the projecting first focusing element so as to alter the position of the virtual image within the imaging volume, wherein the means for altering the effective optical path length comprises the optical path length adjuster according to any one of claims 1 to 19.

23. A method for varying an optical path length between an input optical path (52) and an output optical path (54) of an optical path length adjuster (53), comprising the steps of :

providing an input beam of light on the input optical path and passing it into a plurality of first optical elements (61) and second optical elements (62) arranged in alternating sequence along the optical path;

determining a polarisation state of the input beam at each first optical element through which the beam passes; and

either transmitting or reflecting the beam at each second optical element (62) on which the beam is incident, depending on the selected polarisation state of the incident beam;

wherein the optical path length traversed by the input beam on the optical path can be varied by selecting a particular second optical element (62) at which reflection of the input beam is to occur, the reflected input beam emerging along the output optical path.

24. The method of claim 23, in which the determining step either changes or maintains the polarisation state of the beam, so as to select a preferred polarisation state.

25. The method of claim 24, in which the polarisation state of the beam is changed by switching a polarising switch (61a, 61b, 61c) in the first optical element (61) from one polarising state to another polarising state.

26. The method of claim 24, in which a preferred polarisation state is selected for each second optical element (62) on which the beam is incident, so as to correspond to a polarisation state which is either transmitted or reflected by each particular second optical element (62).

27. The method of claim 23, in which the second optical element (62) comprises a wire grid polariser (62a, 62b, 62c) and the preferred polarisation state is selected so as to be parallel to the direction of the wires if the beam is to be reflected and orthogonal to the direction of the wires if the beam is to be transmitted.

28. The method of claim 27, in which consecutive second optical elements (62) are arranged so that the direction of the wires of the wire grid polariser (62a, 62b, 62c) are orthogonal to the direction of the wires of a preceding wire grid polariser.

29. The method of any preceding method claim, in which the optical path length is dependent on at least the number of second optical elements (62) which transmit the beam and the spacings (d_1, d_2) therebetween.

30. The method of any preceding method claim, in which arranging the plurality of first optical elements (61) and second optical elements (62) in alternating sequence produces a layered stack configuration (60), having a face layer corresponding to a first optical element and a base layer which only reflects.

31. The method of claim 30, in which the arranging places the layers in contact with each other or holds the layers in spaced relation.

32. The method of claim 30, in which the optical path length depends on at least the position of the layer within the stack which includes the particular second optical element (62) selected to reflect the beam.

33. The method of claim 30, in which the beam is reflected from the base layer if each of the second optical elements (62) transmits the beam.

34. The method of any one of the claims 23 to 33 further including passing light from the output optical path (54, 54a, 54b, 54c) to an input optical path (52) of a downstream optical path length adjuster and repeating the steps for adjusting the optical path length.

35. The method of claim 34 further including the step of selecting different optical path lengths within each said optical path length adjuster.

36. A method for generating a three-dimensional volumetric image, comprising the steps of:

generating a two-dimensional image on a two-dimensional image display panel (41, 46);

projecting the two-dimensional image to a virtual image (40, 45) in an imaging volume (44, 49) with a first focusing element (42, 47); and

altering the optical path length between the display panel and the projecting focusing element so as to vary the position of the virtual image within the imaging volume according to the method of any one of claims 31 to 33.

37. An optical path length adjuster substantially as described herein with reference to the accompanying figures 6 to 9.

38. A method for varying an optical path length between an input optical path (52) and an output optical path (54) of an optical path length adjuster (53) substantially as described herein with reference to the accompanying figures 6 to 9.